Chapter 7: System Test

WARNING: Adjust the unit as outlined Chapter 7 if any repairs are made that replace major subassemblies (such as the blower, valve, circuit boards) or that affect the air stream integrity (such as the muffler or flow tubes).

CAUTION: Electronic components used in this unit are subject to damage by static electricity. Use proper static discharge and grounding precautions when servicing this equipment. Service only at a static-free workstation.

7.1 Requirements

7.1.1 Equipment

- Frequency Counter—Simpson 711 or see Appendix A
- Oscilloscope—Hewlett-Packard 54501A or see Appendix A
- Multimeter—Amprobe AM 12 or see Appendix A
- Electronic manometer—Respironics, Inc. with tubing or see Appendix A
- Watt meter (150W full scale, 1W resolution) with unit power cord
- Flow meter system—see Appendix A
- Flow valve—Included in the BiPAP small tool kit, Respironics #332301
- BiPAP 30 DCP (for S/T-D 30 units only)
- O_2 ports (2)
- O_2 port with 0.25" orifice
- Six feet of smooth inner lumen tubing
- Antistatic work area—minimum is a mat, wrist strap, and ground cord
- Potentiometer adjustment tool

7.1.2 Data Sheet

Complete a data sheet for each system test you perform. Appendix B contains the sheets, which you may copy for each test you perform. The sheet is two-sided; one side of the System Data Sheet may be used for the adjustment and the other side for the final.

7.1.3 Test Sequence

The required test is performed in three steps. The system adjustment is used to make adjustments to the unit to meet the specifications. The unit is run for 2 hours, and then a system final is performed. The system final is used to verify the specifications.

1. Run the unit for one hour with IPAP set to maximum and EPAP set to minimum.
2. Perform the system adjustment.
3. Run the for a minimum of 2 hours.
4. Perform the system final.

7.2 BiPAP Setup

1. Plug the BiPAP 30 unit into a wall outlet.
2. Turn the BiPAP 30 unit ON (|); set the IPAP to maximum and the EPAP to minimum.
3. Allow the unit to warm up for a minimum of one hour.

NOTE: The BiPAP 30 has a larger transformer than the BiPAP 20 and therefore must be warmed up for one hour before the system adjustments are made. This optimizes the system adjustments to the center of the specification range.

4. Turn the unit OFF, unplug it, and move it to an antistatic work area.
5. Remove the wraparound and top plate as described in Section 6.2.1.
6. You will access six electrical signals during the system tests. These signals may be obtained from the 8-pin connector on the BiPAP 30 Control Board (BCB) on all units. Figure 7-1 shows the pin assignments for the 8-pin connector. Use a 2.2 KΩ resistor in series with the signal outputs from pins 2-6.

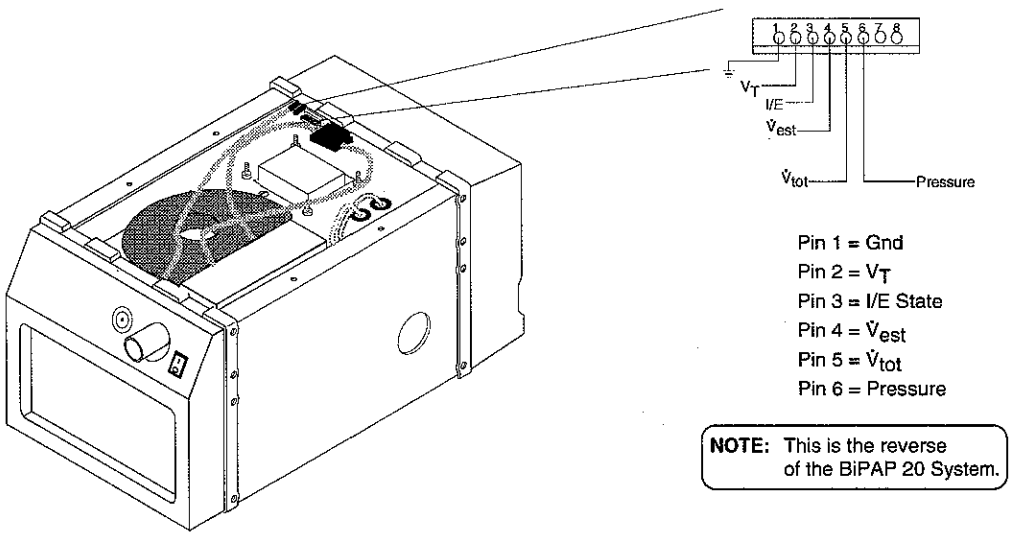


Figure 7-1

7.3 Initial Equipment Setup

Figure 7-2 shows the initial equipment setup.

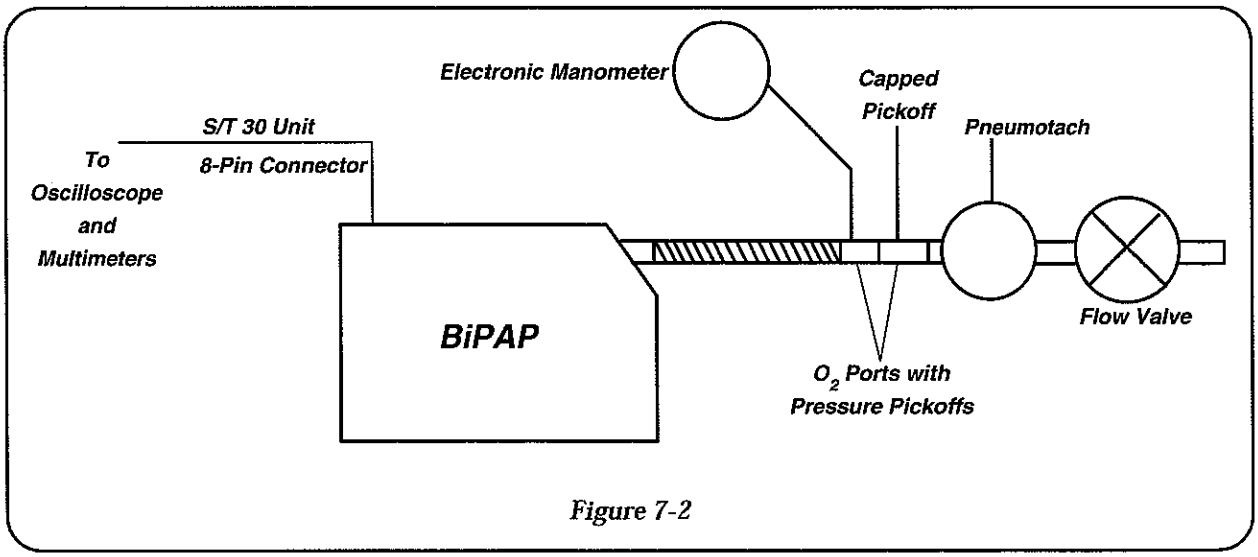


Figure 7-2

1. Plug the BiPAP 30 unit to be tested into the watt meter. Plug the watt meter into a power source.

2. Insert two O_2 ports into the end of a six-foot tube with a smooth inner lumen. Attach the pneumotach to the end of the second O_2 port and install the flow valve downstream of the pneumotach . Cap off one of the O_2 pick-offs; attach a length of tubing from the other O_2 port pick-off to an electronic manometer.

3. Record the time meter reading and proceed with the tests.

NOTE:	If at any time during the following tests the unit fails to meet the specifications as stated, repeat the test for the appropriate specification. If the unit fails a second time, mark in the comment area what the problem is, record the hour meter reading, sign and date the history papers, and prepare the unit for repair. See Section 7.6 for corrective actions to take for a failure in any test.
CAUTION:	Wear a grounding wrist strap to prevent static electric damage any time a unit is being handled or tested.
CAUTION:	Electrical shock hazard.

7.4 System Adjustment

7.4.1 Motor Speed Adjustment

Test Equipment Setup

The test equipment remains the same from the Initial Setup, Section 7.3, with the addition of the Simpson Frequency Counter (see BiPAP 30 Setup).

BiPAP 30 Setup

Figure 7-3 shows the location of test points TP1 and TP2 and the location of the trimpot R5 on the Motor Control Board (MCB).

1. Place the BiPAP 30 unit on its side and place the bottom panel on the workbench.
2. Connect the red lead of the Simpson 711 Frequency Counter to TP2 on the MCB. Connect the black lead to TP4 of the MCB. Set the frequency counter to the "Hz" setting.
3. Set the BiPAP 30 function selector switch to the IPAP mode.
4. Set the IPAP control knob to maximum (full clockwise).

Test Procedure

Step 1 Turn the BiPAP 30 unit on.

Step 2 Adjust trimpot R5 on the MCB so that the frequency counter reads 4800 Hz (±20 Hz). Record the frequency on the data sheet.

Step 3 Rotate the EPAP control and verify that the motor speed does not change.

Step 4 Set the mode to EPAP and set the EPAP control to maximum.

Step 5 Verify that the frequency counter reads 4800 Hz (±20 Hz).

Step 6 Rotate the IPAP control and verify that the motor speed does not change.

Step 7 Turn the BiPAP 30 unit off and remove the frequency counter leads from the MCB.

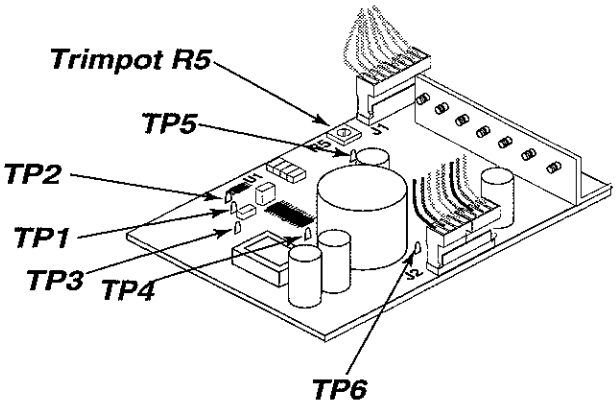


Figure 7-3

Step 8 Install the bottom plate on the BiPAP 30 unit using four of the six rubber feet.

7.4.2 Flow Transducer Adjustment

Test Equipment Setup

The test equipment remains the same from the Initial Setup, Section 7.2.

BiPAP 30 Setup

1. Connect the free end of the six-foot tubing to the outlet of the BiPAP 30 unit.
2. Close the flow valve.
3. Set the BiPAP 30 function selector switch to the IPAP mode.
4. Set the IPAP control knob to maximum (full clockwise).
5. Set the $\dot{V}_{tot}$ (total flow) multimeter to read millivolts (DC mV range 2000 on Amprobe).

Figure 7-4 shows the location of the BCB trimpots.

Test Procedure

NOTE: The two adjustment pots—R171 and R170—that you are about to adjust are mounted in reverse order from the BiPAP 20 mounting. That is, here in the BiPAP 30 the right-hand pot is adjusted first for 0, and then the left-hand pot is adjusted second for 1.00 V.

Step 1 Adjust R171 for 0.000 VDC on the $\dot{V}_{tot}$ meter (± 0.010 V). Remove the adjustment tool from the trimpot and allow the setting to stabilize before continuing.

Step 2 Adjust the flow valve for 60 L/min (±1 L/min) on the pneumotach.

Step 3 Switch the $\dot{V}_{tot}$ meter to DCV range 20.

Step 4 Adjust R170 for 1.000 V (±0.010 V) on the $\dot{V}_{tot}$ meter.

Step 5 Close the flow valve and verify that zero flow produces 0.000 VDC (± 0.010 V) on the $\dot{V}_{tot}$ meter. Record the voltage on the data sheet for 0 L/min if it is within specification.

Step 6 If the zero flow voltage is not within specification, repeat Steps 1-4.

Step 7 Adjust the flow valve for 30 (±1), 60 (±1), 90 (±1), and 120 (±1) L/minin flow and record the $\dot{V}_{tot}$ reading for each step.

7.4.3 Valve Control Adjustment

Test Equipment Setup

The test equipment remains the same from the Initial Setup, Section 7.2.

BiPAP 30 Setup

1. Close the flow valve.
2. Set the BiPAP 30 function selector switch to the IPAP mode.
3. Set the IPAP control knob to maximum (full clockwise).

Figure 7-4 shows the location of the trimpots on the BCB.

Test Procedure

Step 1 Turn the IPAP control knob to the 28 cm H_2O indicator mark.

Step 2 Adjust R84 for 28.0 cm H_2O (± 0.2 cm) on the manometer.

Step 3 Turn the IPAP control knob to the 30, 24, 20, 18, 12, 6, and minimum indicator marks and record the pressure for each control knob setting.

Step 4 Turn the function selector knob to the EPAP mode and repeat Step 3 using the EPAP control knob.

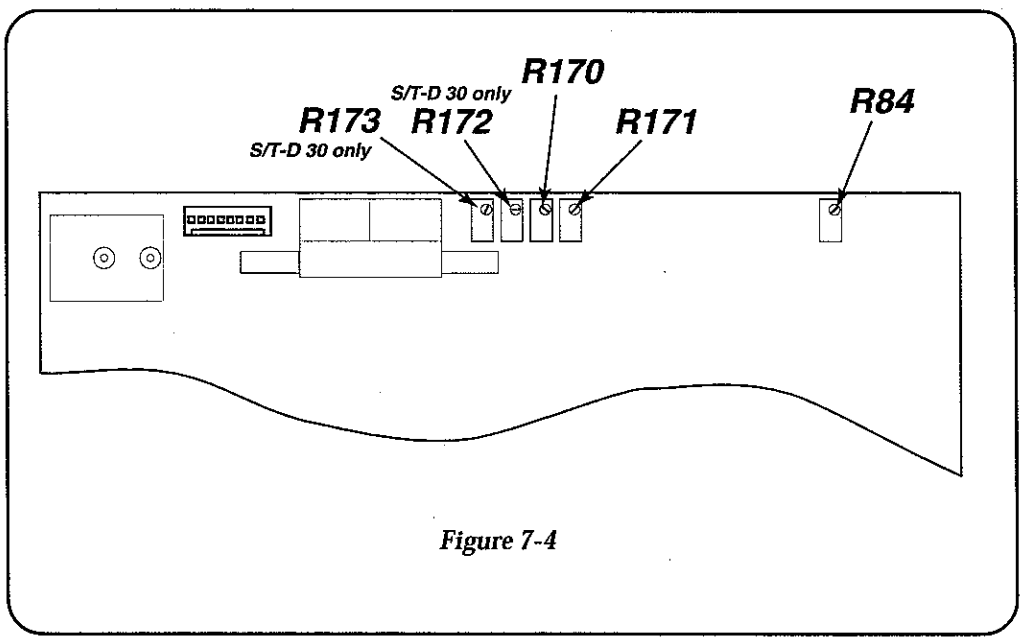


Figure 7-4

7.4.4 Pressure vs. Flow Adjustment

Test Equipment Setup

The test equipment remains the same from the Initial Setup, Section 7.2.

BiPAP 30 Setup

1. Close the flow valve.
2. Set the BiPAP 30 function selector switch to the IPAP mode.
3. Set the IPAP control knob to maximum (full clockwise).

Figure 7-5 shows the location of the trimpots on the BCB.

Test Procedure

Step 1 Set the IPAP control knob to indicate 29.0 cm H_2O (±0.1cm H_2O) on the manometer at 0 L/min (±1 L/min) on the flow meter.

Step 2 Set the flow valve for 50 and 100 L/min (±1 L/min) and record the pressure and flow for each setting.

Step 3 Set the IPAP control knob to 24.0 cm H_2O (±0.1cm H_2O) on the manometer.

Step 4 Set the flow valve for 50 and 100 L/min (±1 L/min) and record the pressure and flow for each setting.

Step 5 Set the IPAP control knob to 18.0 cm H_2O (±0.1cm H_2O) on the manometer.

Step 6 Set the flow valve for 50 and 100 L/min (±1 L/min) and record the pressure and flow for each setting.

Step 7 Set the IPAP control knob to indicate 12.0 cm H_2O (±0.1cm H_2O) on the manometer at 0 L/min (±1 L/min) on the flow meter.

Step 8 Set the flow valve for 50 and 100 L/min (±1 L/min) and record the pressure and flow for each setting.

Step 9 Set the IPAP control knob to 6.0 cm H_2O (±0.1cm H_2O) on the manometer.

Step 10 Set the flow valve for 50 and 100 L/min (±1 L/min) and record the pressure and flow for each setting.

NOTE: Some RT200s may indicate pressures that are a couple of centimeters low for the 29.0 @ 100 and 24.0 @ 100 settings and may be unable to do any of the lower 100 settings.

7.4.5 Pressure Monitor Adjustment (S/T-D units only)

Test Equipment Setup

The test equipment remains the same from the Initial Setup, Section 7.2.

BiPAP 30 Setup

1. Close the flow valve.
2. Set the BiPAP 30 function selector switch to the IPAP mode.
3. Set the IPAP control knob to minimum (full counterclockwise).

Figure 7-5 shows the location of the trimpots on the BCB.

Test Procedure

Step 1 Set R173 for 0 VDC (+0.14 to 0.0 V) on the pressure meter.

Step 2 Remove the cap from the capped O_2 port pressure pickoff and attach tubing from pressure pickoff to the pressure port on the BiPAP 30 unit.

Step 3 Adjust the IPAP control knob for 10.0 cm H_2O (± 0.10 cm) on the manometer.

Step 4 Adjust R172 for 1.0 VDC (± 0.10 V) on the pressure meter.

Step 5 Remove the tubing from the BiPAP 30 pressure port and record the pressure meter reading, which should be 0.00 to 0.10 VDC. Reattach the pressure tubing to the BiPAP 30 pressure port.

Step 6 Set the IPAP control knob for 5 (±0.1), 10 (±0.1), 15 (±0.1), 20 (±0.1), 25 (±0.1), and 28 (±0.1) cm H_2O and record the pressure meter voltage for each setting.

Step 7 Recap the O_2 port.

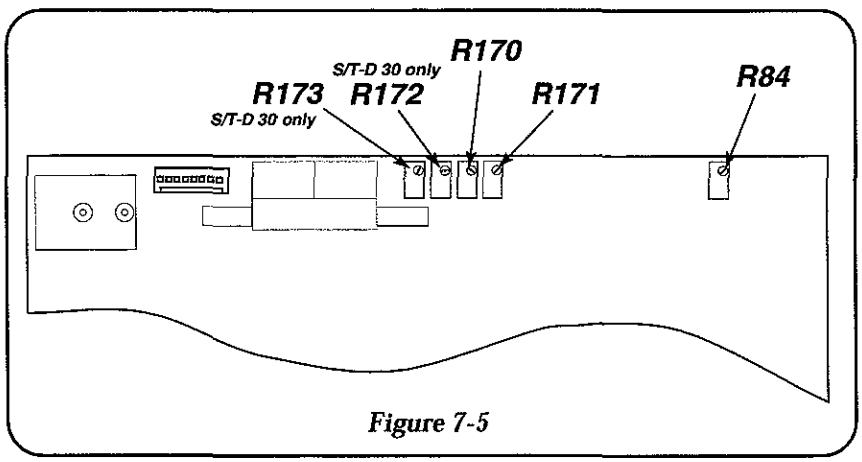


Figure 7-5

7.4.6 Blocked and Unblocked Watts

Test Equipment Setup

The test equipment remains the same from the Initial Setup, Section 7.2.

BiPAP 30 Setup

1. Disconnect the pressure tubing from the BiPAP 30 unit and close the flow valve.
2. Set the BiPAP 30 function selector switch to the IPAP mode.
3. Set the IPAP control knob to maximum (full clockwise).

Test Procedure

Step 1 Record the blocked AC watts on the System Data Sheet.

Step 2 Remove the tubing from the air outlet and record the unblocked AC watts. The unblocked watts must be less than 110 watts.

Step 3 Record the hour meter reading on the System Data Sheet.

7.4.7 Trigger Level

Test Equipment Setup

1. Install the 0.25" orifice on the outlet of the BiPAP 30 unit.

BiPAP 30 Setup

1. Set the BiPAP 30 function selector switch to the SPONTANEOUS mode.
2. Set the IPAP control knob to 12.
3. Set the EPAP control knob to 4.

Test Procedure

Step 1 Turn the BiPAP 30 unit on.

Step 2 Block and unblock the 0.25" orifice with a finger and verify that the unit switches between EPAP and IPAP respectively. Verify that the EPAP and IPAP LEDs on the control panel switch accordingly.

Step 3 Mark pass or fail (P or F) on the data sheet.

7.5 Run-In Test

All units that have been repaired must be run for a minimum of 2 hours before performing the system final. The following procedure outlines the settings for the run.

NOTE: Conditions that may be difficult to diagnose or confirm, such as temperature problems, failure to cycle, blown fuses, or intermittent problems, may be run for a longer period of time (8 hours is suggested).

The wraparound should be in place.

BiPAP 30 Setup

1. Set the BiPAP 30 Function Selector Switch to the Timed mode.
2. Set the IPAP control to 12 cm H_2O and the EPAP control to 5 cm H_2O.
3. Set the BPM control to 12.
4. Set the %IPAP control to 50.
5. Place a 0.25" orifice on the BiPAP 30 outlet.

Test Procedure

Step 1 Verify that the wraparound is in place. Plug in the AC cord, turn the unit on, and allow it to run for a minimum of 1 hour.

NOTE: If the unit has been run longer than one hours, as an effort to check one of the conditions difficult to diagnose, remove the 0.25" orifice, attach a 6 foot length of tubing, attach the 0.25" orifice to the end of the tubing, and check the temperature at the orifice. See the temperature specification in Chapter 2.

7.6 System Final

7.6.1 Verify System Adjustment

1. All equipment remains the same as in Section 7.4.
2. Repeat procedures 7.4.1 to 7.4.6 without making any adjustments. Record the measurements on the data sheet.
3. Remove the six-foot tubing and all other flow and pressure measuring equipment.
4. Install a 0.25" orifice on the outlet of the unit.

7.6.2 Equipment Setup

The tests in this section require three oscilloscope setups. If you are using an HP oscilloscope with a recall function, set the memories as follows:

Recall 1

Timebase:	1 second / division
Sensitivity:	500 mVDC / division, both channels
Measure:	Period, Duty cycle, V_{pp} on Channel 1

Recall 2

Timebase:	5 seconds / division
Sensitivity:	5 VDC / division, Channel 1
	500 mVDC / division, Channel 4
Measure:	Period, Duty cycle on Channel 1

Recall 3

Timebase:	1 second / division
Sensitivity:	500 mVDC / division, both channels
Measure:	None

7.6.3 Spontaneous Mode Verification

Test Equipment Setup

1. Connect Channel 1 of the oscilloscope to the VT signal (Pin 2 of the 8-pin connector) and Channel 2 of the scope to the $\dot{V}_{est}$ signal (Pin 4 of the 8-pin connector).

2. If you are using the HP oscilloscope , use Setup 3. Otherwise, set up the scope channels as follows:
   - Timebase: 1 sec/div
   - Sensitivity: Channel 1—500 mV/div
     Channel 2—500 mV/div
   - Measure: none

3. Keep the 0.25" orifice on the outlet.

BiPAP 30 Setup

1. Set the BiPAP 30 selector switch to the SPONTANEOUS mode.

2. Set the IPAP control knob to 12.

3. Set the EPAP control knob to 4.

Test Procedure

Step 1 Block and hold the orifice with a finger and observe that the $\dot{V}_{est}$ signal starts to ramp toward 0 V after a short delay and that the VT signal resets. Verify that $\dot{V}_{est}$ is at 0 V before continuing. See Figure 7-6.

Step 2 See Figure 7-7 for oscilloscope traces. Unblock the orifice, watch the VT signal ramp for approximately 1.0 seconds, and then block the orifice. Be sure to block the orifice as soon as the VT signal levels out.

Step 3 The VT signal should reset after 4.40 to 5.95 seconds. Shortly after the VT resets, stop the scope trace near the edge of the screen (press Run/Stop).

Step 4 Measure the time between blocking the orifice ($\dot{V}_{est}$ reset) and VT reset. Record the measurement on the data sheet.

Step 5 Verify that if EPAP is set higher than IPAP, only IPAP works.

Step 6 Block and unblock the outlet orifice with a finger. Verify that the unit switches between EPAP and IPAP and that the respective LEDs switch accordingly.

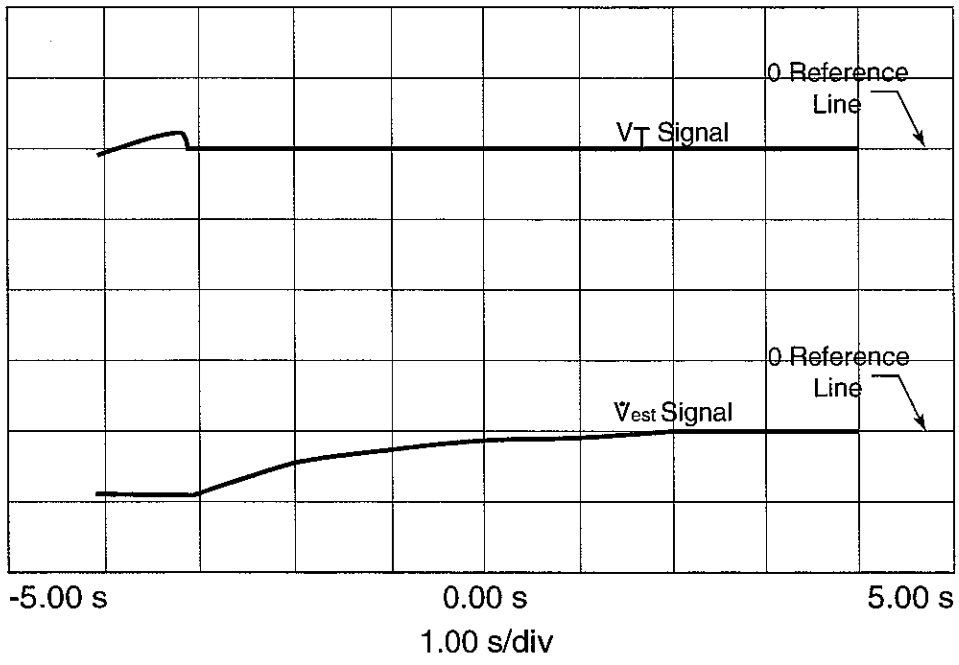


Figure 7-6

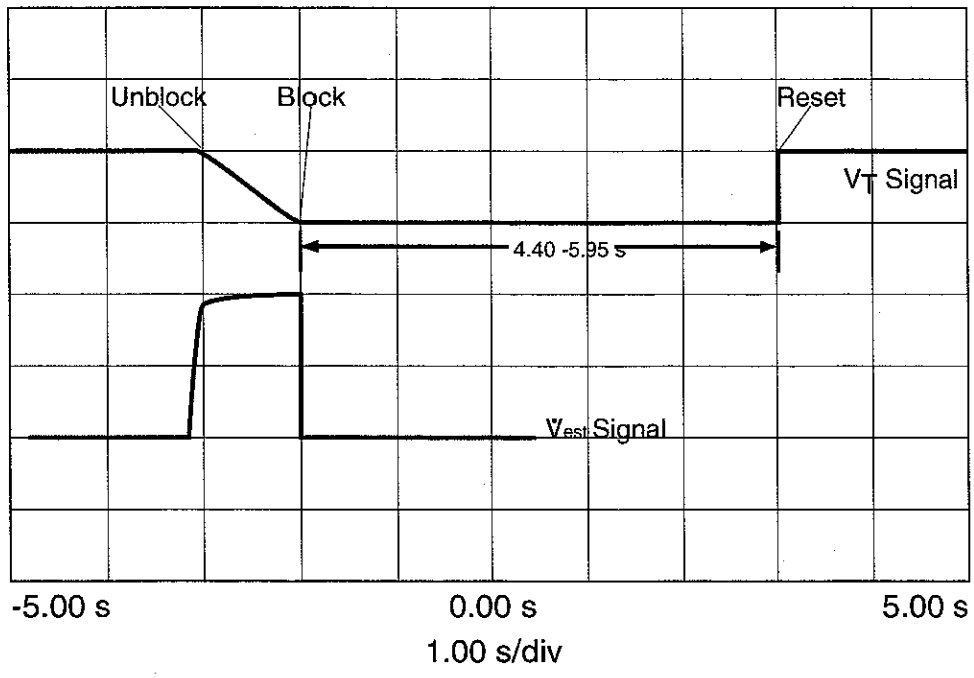


Figure 7-7

NOTE: Traces shown are for a BiPAP S/T 30 unit. The plateau on the V_T signal is inverse and goes up on the BiPAP S/T-D 30 unit. The $\ddot{V}_{est}$ short plateau points up on both units.

7.6.4 Spontaneous/Timed Mode Verification

Test Equipment Setup

1. Connect Channel 1 of the oscilloscope to the I/E state signal (Pin 3 of the 8-pin connector) and Channel 2 of the scope to the $\dot{V}_{est}$ signal (Pin 4 of the 8-pin connector). If you are using the HP oscilloscope, use Setup 2. Otherwise, set up the scope channels as follows:

   - Timebase: 5 sec/div
   - Sensitivity: Channel 1—5 V/div
     Channel 2—500 mV/div

2. Change the timebase to 1 sec/div.

3. Keep the 0.25" orifice on the outlet.

BiPAP 30 Setup

1. Set the BiPAP 30 selector switch to SPONTANEOUS/TIMED mode.

2. Set the IPAP control knob to 12.

3. Set the EPAP control knob to 4.

4. Set the BPM control knob to 16.

Test Procedure

Step 1 Unblock and block the orifice faster than the BPM rate (3 seconds). Verify that the unit switches between EPAP and IPAP and the respective LEDs switch accordingly.

Step 2 Observe that a timed pulse does not occur as long as the orifice is being blocked and unblocked faster than the BPM rate (3 seconds).

Step 3 Block and hold the orifice and allow the unit to cycle to EPAP. Verify that the amber LED below the BPM mode knob lights.

Step 4 Verify that the timed pulse occurs on the I/E state signal.

Step 5 Unblock the orifice until the unit triggers into IPAP. Block the orifice until two pulses occur on the scope. Your scope should look like Figure 7-8.

Step 6 Press "Run/Stop."

Step 7 Measure the time between the first pulse and the second pulse. Verify the time is 3.75 sec ±0.5 sec.

Step 9 Mark pass or fail (P or F) on the data sheet.

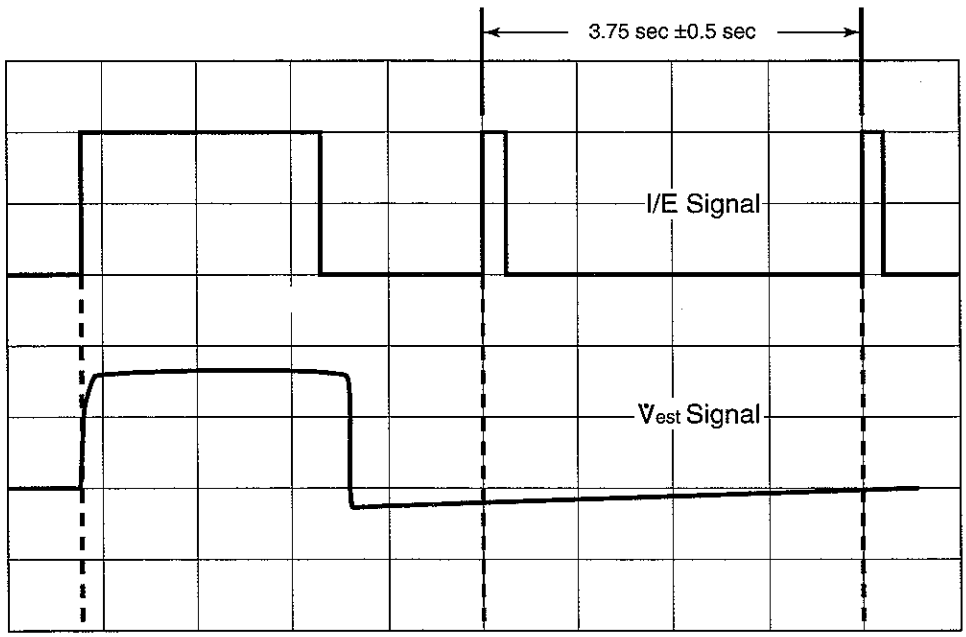


Figure 7-8

7.6.5 Timed Mode Verification

Test Equipment Setup

1. If you are using the HP oscilloscope, use Setup 2. Otherwise, connect Channel 1 of the oscilloscope to the I/E state signal (Pin 3 of the 8-pin connector).

2. Set up the scope channel as follows:
   - Timebase: 5 sec/div
   - Sensitivity: Channel 1—5 V/div
   - Measure: period, duty cycle on Channel 1

3. Keep the 0.25" orifice on the outlet.

BiPAP 30 Setup

1. Set the BiPAP 30 selector switch to TIMED mode.

2. Set the IPAP control knob to 12.

3. Set the EPAP control knob to 6.

4. Set the % IPAP control knob to 10% (minimum).

5. Set the BPM control knob to minimum (full counterclockwise).

Test Procedure

Step 1 Verify and record that the I/E signal has a period of approximately 10 to 30 seconds with approximately 10% (±5%) duty cycle. See Figure 7-9 for a representative oscilloscope trace.

Step 2 Adjust the BPM to maximum and the %IPAP to 90% (maximum).

Step 3 Change the timebase on the oscilloscope to 1 sec/division.

Step 4 Clear the display.

Step 5 Verify and record that the I/E signal has a period of approximately 1.8 to 2.2 seconds and a duty cycle of approximately 90% (±5%). See Figure 7-10.

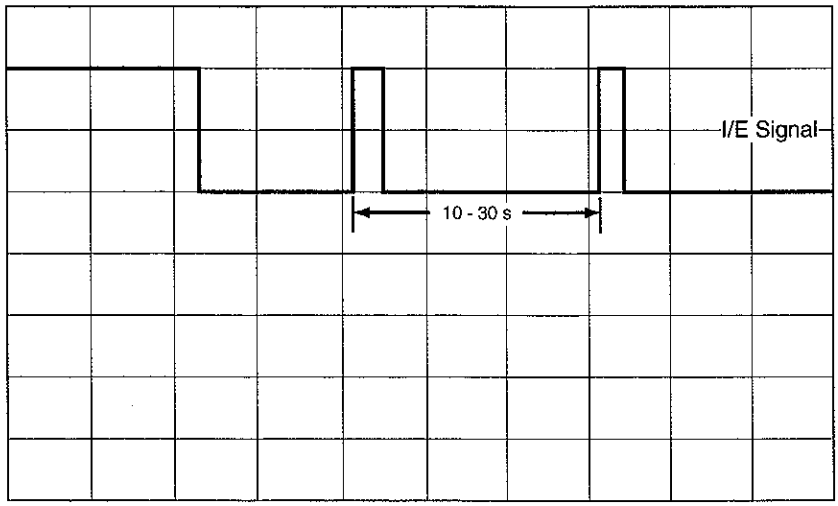


Figure 7-9

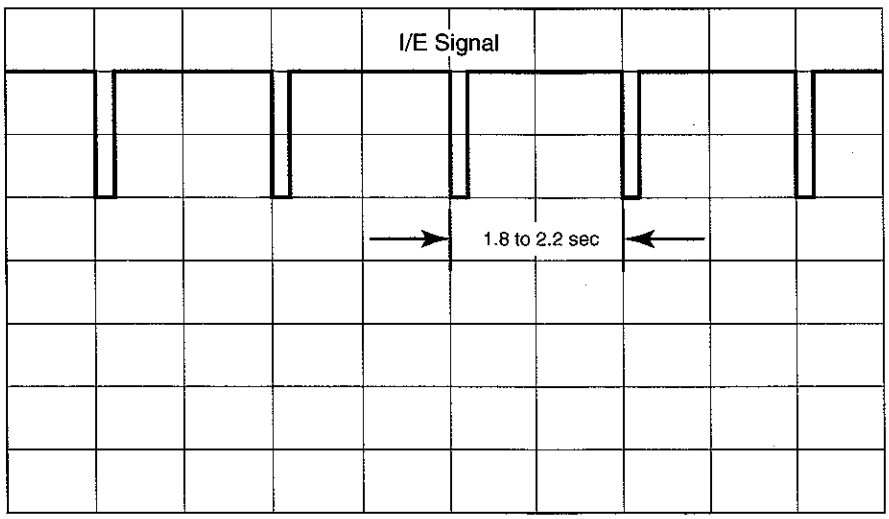


Figure 7-10

7.6.6 DCP Verification (S/T-D 30 only)

Test Equipment Setup

1. All test equipment should be the same as for 7.5.5.

BiPAP 30 Setup

1. Connect the Detachable Control Panel (DCP 30) to the DCP connector on the rear of the BiPAP S/T-D 30 unit.

Test Procedure

Step 1 Verify that the rear panel controls are inactive.

Step 2 Verify that the DCP Zero sets all signals to 0 V.

Step 3 Verify that the DCP Cal sets Flow, Flow est to ±0.5 V square waves, and volume to 0.5 V_{PP} triangle wave.

Step 4 Verify that the IPAP mode allows the IPAP control to operate and that the IPAP LED illuminates.

Step 5 Verify that the EPAP mode allows the EPAP control to operate and that the EPAP LED illuminates.

Step 6 Verify that the Spontaneous mode operates by blocking and unblocking the orifice.

Step 7 Verify that the Spontaneous/Timed mode operates like the Spontaneous mode by blocking and unblocking the orifice, then block the orifice and verify that the unit emits timed pulses.

Step 8 Verify that the Timed mode allows BPM and %IPAP controls to operate with IPAP at 12 and EPAP at 6.

Step 9 Mark pass or fail (P or F) on the data sheet.

Step 10 Turn off the unit and disconnect the power cord, test cable, and any tubing or test orifice.

7.7 Corrective Actions

In case of a failure during the adjustment or final, use the following table for corrective actions. Replacement procedures appear in Chapter 6.

TEST FAILURE	CORRECTIVE ACTIONS
7.4.1 Motor Speed	1. Reset the motor speed per 7.4.1. 2. If the motor speed is out of spec: a. Replace the blower (see 6.2.5) or b. Replace the MCB (see 6.2.9).
7.4.2 Flow Adjustment	1. Reset the flow adjustment. 2. If the flow adjustment fails after resetting: a. Check flow sensor tubing between the blower and the rear board. Verify that tubing is the correct size. b. Replace the blower (see 6.2.5) or c. Replace the BCB (see 6.2.10).
7.4.3 Valve Adjustment	1. Reset R84 for 28.0 cm H_2O per Section 7.4.3. 2. Retest. 3. If the valve adjustment fails again: a. Check the valve for contaminants. b. Replace valve and repeat test. c. If problem still exists, replace the BCB (see 6.2.10).
7.4.4 Pressure vs. Flow	1. If the test fails , repeat 7.4.1 through 7.4.3. 2. If the test fails again replace the BCB (see 6.2.10).
7.4.5 Pressure monitor	1. If the test fails , repeat 7.4.1 through 7.4.3. 2. If the test fails again replace the BCB (see 6.2.10). 3. If the problem still exists, replace the blower (see 6.2.5).
7.4.6 Trigger	1. Repeat test; if it fails again replace the BCB (see 6.2.10) 2. If failure still exists, replace the trigger board (see 6.2.15).
7.4.7 Blocked/Unblocked	1. Repeat test; if it fails again, replace the blower (see 6.2.10). 2. If it fails again, replace the MCB (see 6.2.9). 3. If it fails again, replace the transformer (see 6.2.14).

Continued on next page

TEST FAILURE	CORRECTIVE ACTION
7.6.3 Spontaneous Mode	1. Repeat test; if it fails again, replace the BCB (see 6.2.10). 2. If it fails again replace the trigger board (see Section 6.2.15).
7.6.4 Spontaneous/Timed	1. Repeat test; if it fails again, replace the trigger board (see 6.2.15). 2. If it fails again, replace the BCB (see 6.2.10).
7.6.5 Timed	1. Repeat test; if it fails again, replace the trigger board (see 6.2.15). 2. If it fails again, replace the BCB (see 6.2.10).
7.6.6 DCP	1. Check the continuity of the DCP cable. 2. Check the DCP on another BiPAP. 3. Replace the BCB (see 6.2.10).

Chapter 8: Repair Parts List and Exploded Views

The repair parts list and exploded views are presented in two figures. The wraparound is not shown.

NOTE: Repair parts are available only to Respironics-trained accounts.

Index Letter From Drawing	Reorder RP Kit Number	Description
A	552065	RP-BiPAP 30 Wraparound Kit
B	552067 (S/T-D)	RP-BiPAP 30 Front End Cap S/T-D
B	552068 (S/T)	RP-BiPAP 30 Front End Cap S/T
C	552127	Main Power Switch, Repair Kit
D	552106	RP-BiPAP 30 Pressure Port Kit
E	552085	RP-BiPAP 30 Flow Pickup Tubes (2/pack)
F	332177	Control Knobs, D Shaft (Set of 5)
G	552066	RP-BiPAP 30 Voltage Selector
H	552090	RP-BiPAP 30 Time Meter Kit
I	332214	AC Inlet Connector with Fuse Drawer, Repair Kit
J	552100	RP-BiPAP 30 2A Fuse Package (2/pack)
K	552088	RP-BiPAP 30 Electronics Kit, S/T-D
K	552089	RP-BiPAP 30 Electronics Kit, S/T
L	552083	RP-BiPAP 30 Motor Control Board Kit
M	552107	RP-BiPAP 30 Screw-on Feet (6/pack)
N	552070	RP-BiPAP 30 Blower Assembly Kit
O	552086	RP-BiPAP 30 Transformer Kit (2/pack)
P	552105	RP-BiPAP 30 Transformer Fuse Kit
Q	332167	RP-BiPAP 30 Valve Kit
R	552084	RP-BiPAP 30 Muffler Kit for units with S/N <100742 (552084 is Obsolete, use 332471)
R	332471	RP-BiPAP 30 Muffler Kit for units with S/N >100742 (Replaces 552084)
S	552104	RP-BiPAP 30 Trigger Board

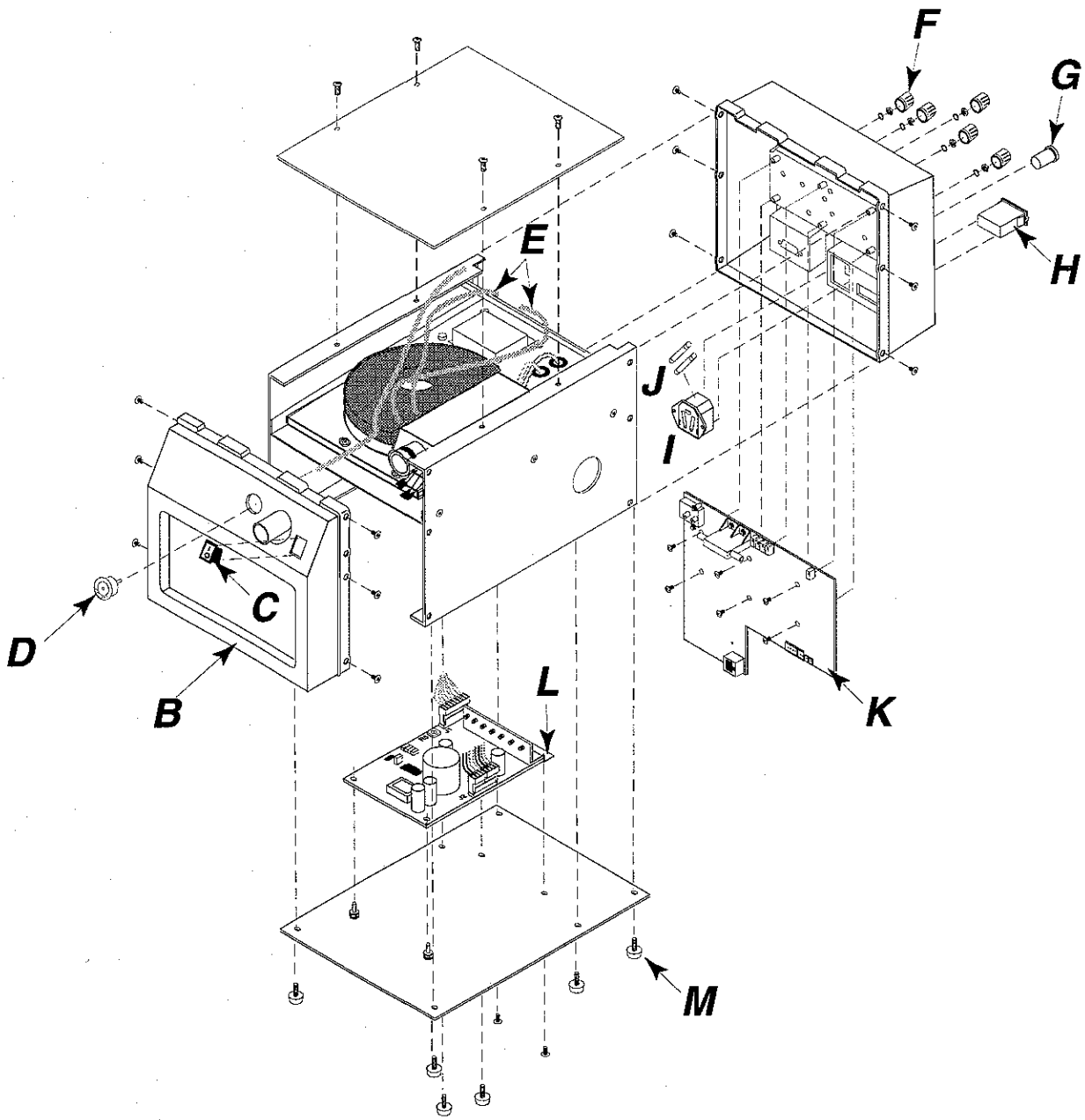


Figure 8-1

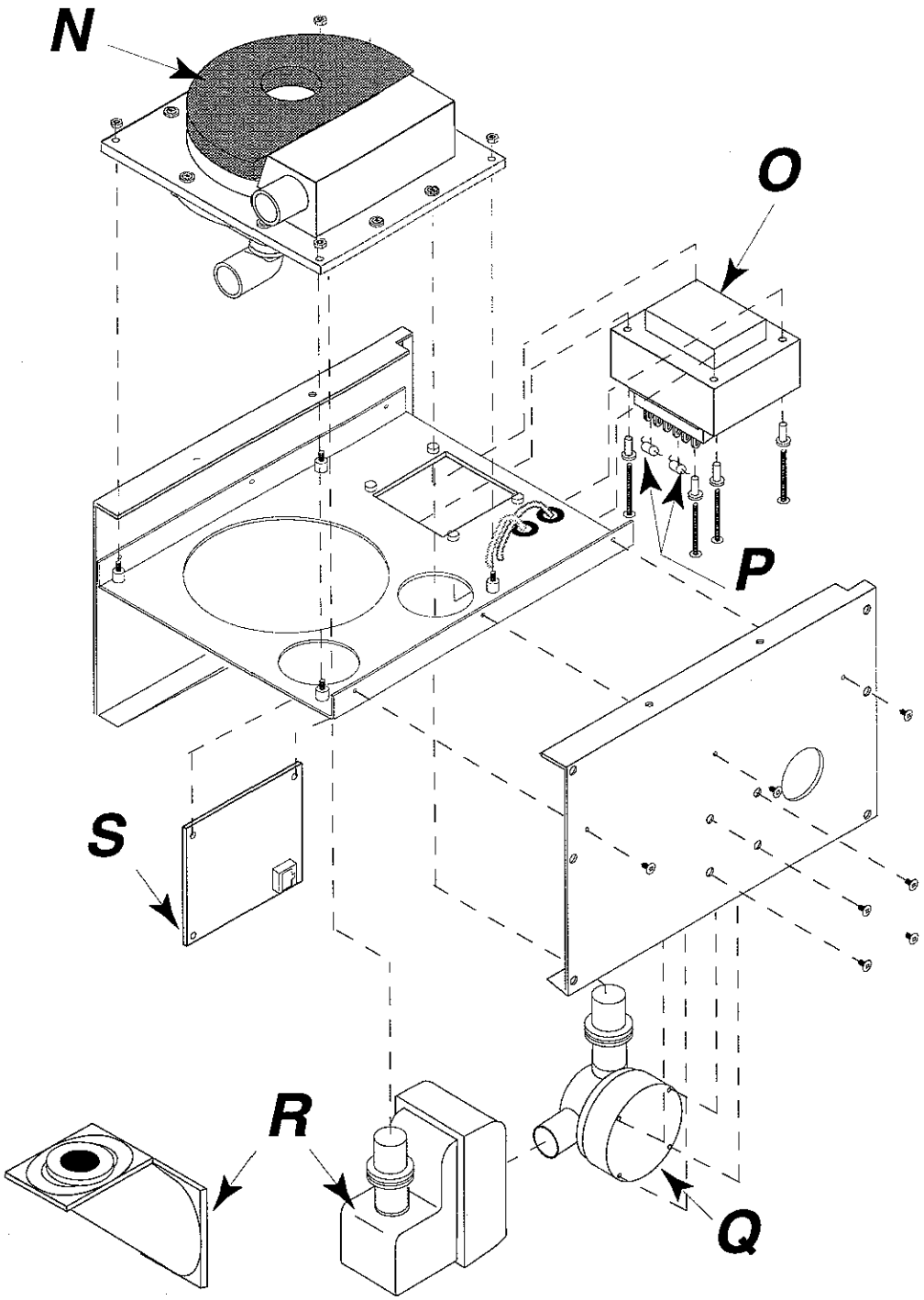


Figure 8-2

A.1 Service Tools

You should have the following tools available for troubleshooting, testing, and repair of the BiPAP unit.

- Common hand tools:
  Flat-blade screwdrivers — at least a small, medium, and large
  Phillips screwdrivers—at least small, medium
  Nut driver set —3/16" to 1/2"
  Hex wrench set —1/16" to 1/2"
  Putty knife, 1" to 2" wide, with sharp edge, for scraping foam
  Straight/open end wrench set, 3/16" to 1/2"
  Scissors
  Needle-nose pliers, medium
  Diagonal cutters, medium
  Wise-grip set, medium
  Razor blade knife
- *Water column manometer with at least 6' of tubing*
- Thermometer — 32 °F to 110 °F, readable to 0.5 °F
- Ruler
- Tie wrap gun
- Antistatic work station — Minimum requirement is a grounded mat and wrist strap
- Digital manometer — See Section A.3
- Hot melt glue gun
- Watt meter — See Section A.3
- Digital multimeters (3) — Amprobe AM12 or equivalent
- Flowmeter — See Section A.3
- Oscilloscope — See Section A.3
- Tubing, 6' smooth inner lumen — Respironics part number 301016
- BiPAP small tool kit — Respironics part number 332301—including:
  Adjustable valve (Respironics part number 331461)
  Tubing coupler (Respironics part number 300176)
  Two O_2 enrichments (Respironics part number 312710)
  Test adaptor — 0.25" (Respironics part number 332353)
  Allen wrench (0.050) (Respironics part number 331462)
- Frequency counter

A.2 Service Supplies

You should have the following supplies available:

- Paper towels
- Disposable gloves
- Cleaner (i.e., Fantastik®, 409®)
- Denatured alcohol
- Loctite 222® removable thread locker
- Pacer PX-500® glue
- Hot melt glue
- Tie wraps (3" x ⅛" and 6" x 3⁄16")
- Cable clips (Stick-on base 1" x ½" holds cable up to ½" diameter)

A.3 Acceptable Electronic Test Equipment

A.3.1 Flowmeter

Specifications: 0 to 150 L/min
3% accuracy
1 L/min resolution

Acceptable options:
1. Respironics System (RI in-house and limited field use only)
2. CME 422-5-200A (SP-1), with 20" pneumotach tube only
3. RT-200 with some limitations

A.3.2 Oscilloscope

Specifications: 2-channel
Storage
Timebases with 1 sec/div and 5 sec/div
Sensitivities of 500 mV/div and 5 V/div

Acceptable options:
Any commercially available oscilloscope that meets the above specifications

A.3.3 Digital Manometer

Specifications: 0 to 35 cm H_2O
±0.3 cm H_2O accuracy
±0.1 cm H_2O resolution

Acceptable options:
1. Respironics 302227 Digital Manometer
2. Merical DP2001
3. Sensym PDM 200CD
4. RT-200
5. Any commercially available digital manometer that meets the above specifications

A.3.4 Wattmeter

Specifications: 0 to 150 W
3% accuracy
1 W resolution

Acceptable options:
1. Yokogawa 2355 (digital)
2. Simpson, Analog 0 to 150 W
3. Extech DW 6060
4. Any commercially available wattmeter that meets the above specifications

A.3.5 Frequency Counter

Specifications: AC Range: 30 Hz to 120 MHz
DC Range: 0.01 Hz to 120 MHz
Four stable digits, e.g., 0.000 for frequencies less than 10 KHz.

Acceptable options:
1. Simpson 711
2. Fluke multimeter internal function
3. Any commercially available frequency counter that meets the above specifications

RESPIRONICS INC.®

BiPAP 30 Preventive Maintenance Schedule

(Factory Recommended)

Patient _____ Servicing Agent _____

Address _____ Address _____

_____ _____

Phone _____ Phone _____

Model _____ Serial# _____ Date Purchased _____

Refer to Section 4.2 of the BiPAP 30 System Service Manual for maintenance and service instructions.

Maintenance Item	Service Interval	Date				
Record hours on meter. See 4.2.1.	Annually, or when service performed					
Verify voltage selector switch. See 4.2.2	Annually					
Inspect fuses. See 4.2.3	Annually					
Test unit control functions. See 4.2.4	Annually					

BiPAP 30 System Adjustment Data Sheet (Pre Run-In)

7.4.1 Blower Motor Speed

Hz	4780-4820 Hz

7.4.2 Flow Transducer Calibration

Flow Meter L/min	0	60
$\dot{V}_{tot}$		
Range (volts)	-0.015 to 0.014	0.985 to 1.014

7.4.3 Valve Calibration

Control Knob Setting	28
IPAP	
EPAP	
Pressure (cm H_2O)	27.7-28.3

7.4.5 Pressure Monitor Calibration (S/T-D 30 Only)

Manometer Pressure Settings	Measurement (volts)	Range (volts)
28.0		2.65 to 2.94

7.4.7 Trigger Level Verification

Time Meter Reading (End) ☐

Pass	Fail
(Circle One)	

Serial Number_____ Signature_____ Date_____ PASS ☐ FAIL ☐

BiPAP 30 System Final Data Sheet (Post Run-In)

7.4.1 Blower Motor Speed

Hz	4780-4820 Hz

7.4.2 Flow Transducer Calibration

Flow Meter L/min	0	30	60	90	120
$\dot{V}_{tot}$					
Range (volts)	-0.035 to 0.034	0.350 to 0.640	0.850 to 1.140	1.300 to 1.690	1.750 to 2.240

7.4.3 Valve Calibration

Control Knob Setting	Min	6	12	18	24	30
IPAP						
EPAP						
Pressure (cm H_2O)	<2.5	3.5 to 8.4	9.5 to 14.4	15.5 to 20.4	21.5 to 26.4	27.5 to 32.4

7.4.4 Pressure vs. Flow Calibration

Flow Valve Settings	**50**	**100**	
Manometer Pressure Settings			Pressure (cm H_2O)
6.0			4.5 to 7.5
12.0			10.5 to 13.5
18.0			16.5 to 19.5
24.0			22.5 to 25.5
29.0			27.5 to 30.5

7.4.5 Pressure Monitor Calibration (S/T-D 30 Only)

Manometer Pressure Settings	Measurement (volts)	Range (volts)
0.0		-0.15 to 0.14
5.0		0.35 to 0.64
10.0		0.85 to 1.14
15.0		1.35 to 1.64
20.0		1.85 to 2.14
25.0		2.35 to 2.64
28.0		2.65 to 2.94

7.4.6 Blocked and Unblocked Watts

WATTS			
Blocked		Unblocked	
	<110		<110

7.4.7 Trigger Level Verification

Pass	Fail
(Circle One)	

7.6.3 & 7.6.4 Spontaneous & Spontaneous/Timed

	Spont.	**Spont/Timed**
S/T		Pass/Fail
S/T-D		Pass/Fail
	4.40 to 5.95 sec	Circle One

7.6.5 Timed Mode Verification

	BPM min	%IPAP min	BPM max	%IPAP max
S/T				
S/T-D				
Range	10 to 30 sec	5 to 15%	1.8 to 2.2 sec	85 to 95%

7.6.6 DCP Verification (S/T-D 30 Only)

Pass	Fail
(Circle One)	

Time Meter Reading (End) _____

Serial Number_____ Signature_____ Date_____ PASS ☐ FAIL ☐

C.1 BiPAP 30 Screening Procedure

NOTE: This procedure and worksheet are optional, and can be used for:

1. Educating people on how the unit functions.

2. "Screening" or checking a new unit that has just been received. (Some hospitals use this as their "check-out" procedure. Some international dealers use this procedure as their "import check-out.")

3. A quick troubleshooting guide (See the figure on page 5-1 for a complete troubleshooting protocol). The procedure can be performed with just the unit and a hook-up to a manometer. (The cover does not have to be removed, an antistatic work station is not needed, and special test equipment is not needed.)

Step 1 Verify that the voltage selector switch is set for the available line voltage.

Step 2 Verify that the fuses are the correct value.

Step 3 Plug the unit into a wall outlet, turn it on, and allow it to warm up for a few minutes.

Step 4 This step verifies the basic IPAP mode function. Set the unit to the IPAP mode. Set the IPAP control to the lowest setting. Connect a water column manometer to any combination of fittings, hoses, etc. that allows the measurement of deadhead pressure. Slowly and smoothly adjust the IPAP pressure upward. The pressure on the manometer should be ±2 cm H_2O of the pressure setting on the control panel. When the entire range from 4 to 30 cm H_2O has been verified, reduce the IPAP pressure to minimum.

Step 5 This step verifies the basic EPAP mode function. Repeat Step 4 using the EPAP control instead of the IPAP control.

Step 6 Remove the fittings, hoses, and manometer.

Step 7 This step verifies the basic triggering and "lockout" features of the Spontaneous mode. Set the unit to the Spontaneous mode. Set the IPAP control to 8 and the EPAP control to 4. Use your hand to open and close the outlet port several times, simulating a person's breathing. Observe the IPAP and EPAP lights to verify that the unit is following the breathing pattern that your hand is creating. While continuing the breathing pattern, gradually turn the EPAP control to 12. Verify that, as the EPAP value becomes higher than the IPAP value, the unit locks out i.e., defaults to the lower pressure value, which is now IPAP, and no longer follows the breathing pattern.

Continue the breathing pattern and gradually turn the IPAP control to 16. Verify that as the IPAP value exceeds the EPAP value, the unit once again follows the breathing pattern. The exact point of the lockout can vary, because the pressure controls are specified to be ±2 cm H_2O. The lockout feature may also be observed at other pressure control settings, within the specified 4 to 30 cm H_2O BiPAP operating range (i.e., the units may be capable of lower and/or higher pressures, but the unit's triggering, lockout, and other behaviors are not assured outside of that range).

Step 8 This step verifies the default and restart of the Spontaneous mode. Set the unit to the Spontaneous mode. Set the IPAP control to 12 and the EPAP control to 5. Use your hand to open and close the outlet port, simulating a person's breathing. Stop the pattern with the port closed. The unit should stop at the EPAP pressure. Restart the pattern of opening and closing. The unit should once again follow the breathing pattern within 3 cycles of the restart.

NOTE: If you stop the pattern with the outlet open, the unit may self-cycle and eventually stop at the EPAP pressure, or the unit may stop at the IPAP pressure. Either behavior is acceptable, because operation in the Spontaneous mode when there is no spontaneous triggering, and with a wide-open leak, does not occur in actual use of the system.

Step 9 This step verifies the basic function of the Spontaneous/Timed mode. Set the unit to the S/T mode. Set the IPAP control to 12, the EPAP control to 5, and the BPM to 20. Use your hand to open and close the outlet port several times. Stop this cycling and leave the port closed. The unit should default to the EPAP pressure; after 3 seconds (corresponding to 20 BPM) the unit should produce a "shot" of air. Keep the outlet closed. The unit should remain at the EPAP pressure, producing a shot of air every 3 seconds. Check this operation at several BPM settings.

Step 10 This step verifies the basic function of the Timed mode. Set the unit to the Timed mode. Set the IPAP control to 12, the EPAP control to 5, the BPM to 20, and the % IPAP to 50. The unit should cycle between IPAP and EPAP based strictly on the BPM and % IPAP settings. The BPM should be ±10% or ±2 BPM, whichever is greater. % IPAP should be ±5%. Verify the operation at several IPAP, EPAP, BPM, and % IPAP settings. Use your hand to close and open the outlet port. Occluding and opening the port should not affect the cycling.

BiPAP 30 SCREENING PROCEDURE WORKSHEET

Serial No._____ Date: _____

Comments: _____

_____

Hour meter reading: _____ Unit Model (circle): S/T 30 S/T-D 30

Normal Unit Settings:

Mode: _____

IPAP: _____ BPM: _____

EPAP: _____ % IPAP: _____

Initial Checks:

Steps 4 and 5 Pressures:

	IPAP and EPAP Control Settings						
	4	8	12	16	20	25	30
Manometer Readings (cm H_2O)							
IPAP							
EPAP							

Basic function of each mode:

Step 7. Spontaneous, Lockout of IPAP, EPAP ..... ☐

Step 8. Spontaneous, default to EPAP, restart ≤3 cycles ... ☐

Step 9. S/T, kick-in ..... ☐

Step 10. T, indep. switching, approx. BPM and % IPAP ... ☐

Further checks, tests, and comments: _____

_____

_____

Date: _____ Initials: _____

D.1 DC Operation

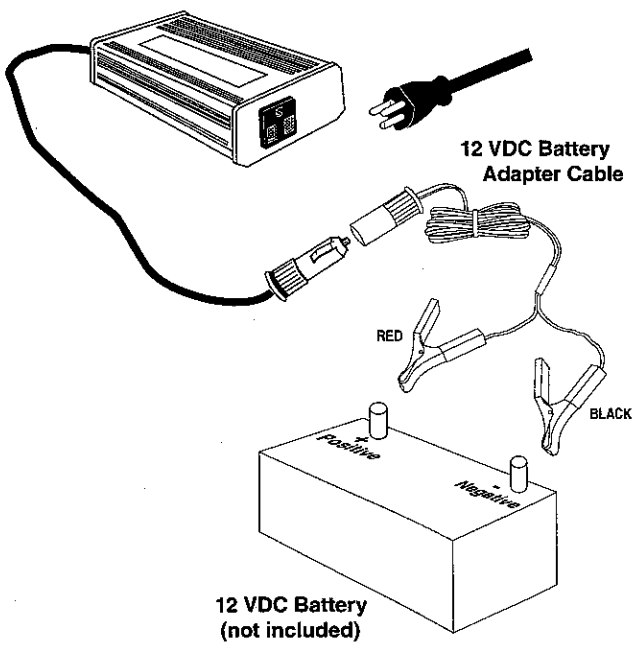
The BiPAP 30 System may be used with a Respironics DC Interface Module, Part Numbers:

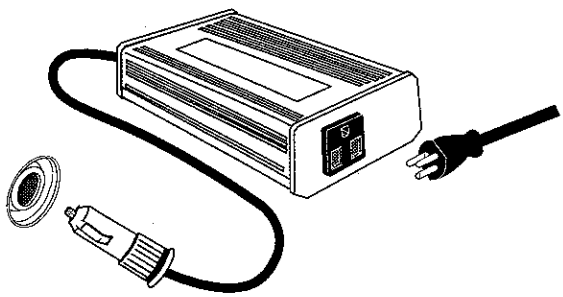
Part #	Description
552097	DC Interface Module
332451	Battery Adapter Cable
552098	DC Interface System Includes: 1 ea. DC Interface Module 1 ea. Battery Adapter Cable
552099	DC Interface System, International Includes: 1 ea. DC Interface Module 1 ea. Battery Adapter Cable 1 ea. U.S. Power Cord, Grounded 2 ea. 800 mA REMstar Fuses 2 ea. 1 A BiPAP Fuses

NOTE: For the BiPAP 30 units, no fuse change is required when using the DC Interface System.

CAUTION: For the BiAPAP 30 units, use only the DC Interface Module with a 150 W label on it.

The figures below illustrate the interface module electrical connection to a battery and to an automobile cigarette lighter. The specifications for the module and for the battery required for operation are on the following page.





D.2 Specifications

Voltage In: 11.5 - 15 VDC

Voltage Out: 115 VAC rms ±5%

When measuring the output voltage, use a true rms-indicating voltmeter to obtain an accurate reading.

Continuous Power: 150 watts

Output Frequency: 60 Hz ± 1%

Efficiency: 90%

Battery Use:

System	Pressure Setting	Battery Size	Length of Operation	Max Current Draw
BiPAP 30 System	**all pressures**	**100 amp-hr**	**9 hrs. (approx.)**	**9.5 amps**

NOTE: Length of operation times are based on normal operating conditions from a fully charged, deep cycle marine-type battery. Battery age, number of recharging cycle, and recharging rates may affect the actual length of operating times.

E.1 Wiring Diagram

Section 5.2 of this manual contains a wiring diagram that shows the major subassemblies of the BiPAP 30 System. This is the level to which service is performed.

E.2 Schematic Statement

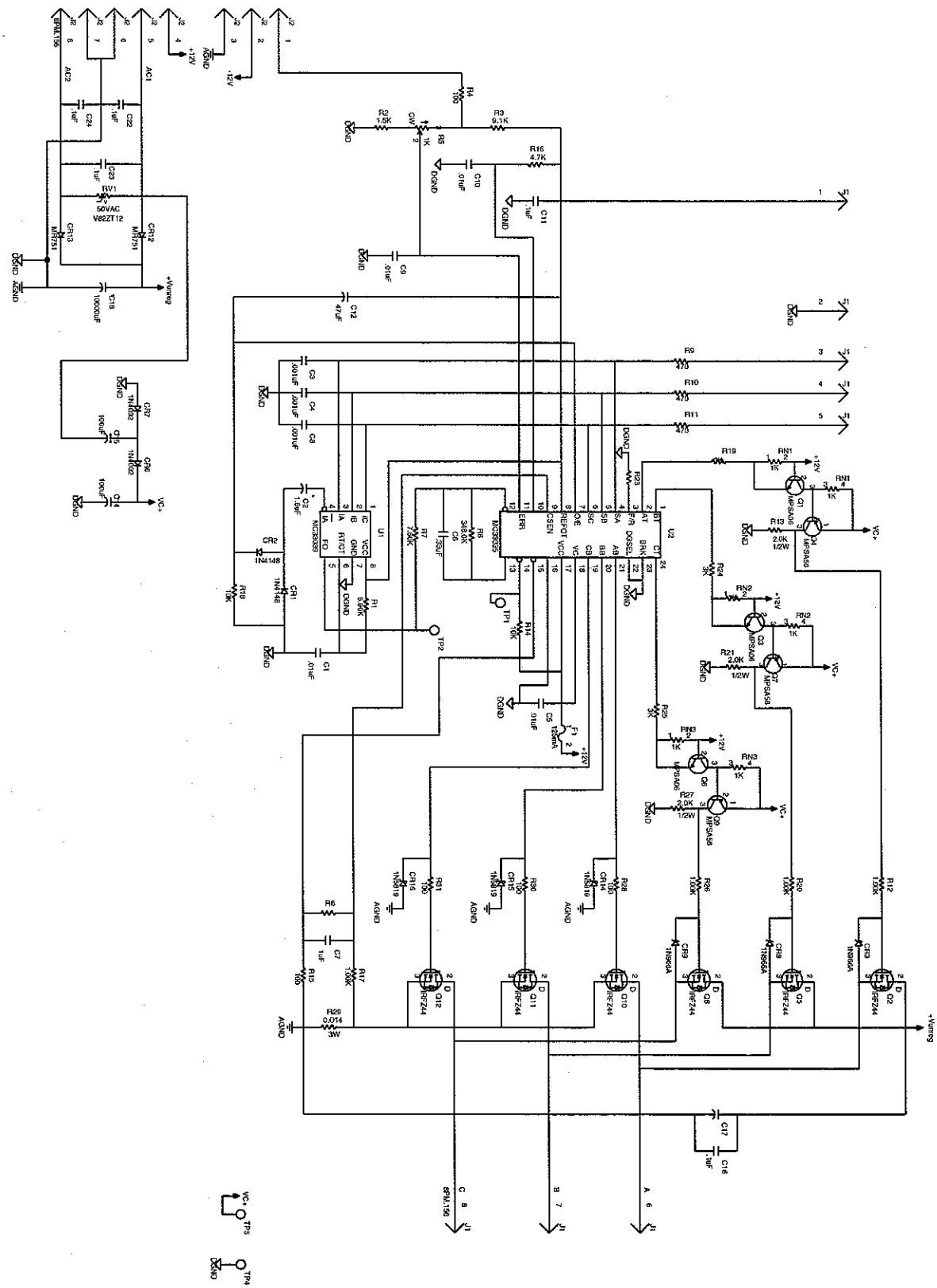
Schematics are supplied with this manual in direct support of the sale and purchase of this product.

The schematics are *proprietary and confidential*. Do not copy the schematics or disclose them to third parties beyond the purpose for which they are intended.

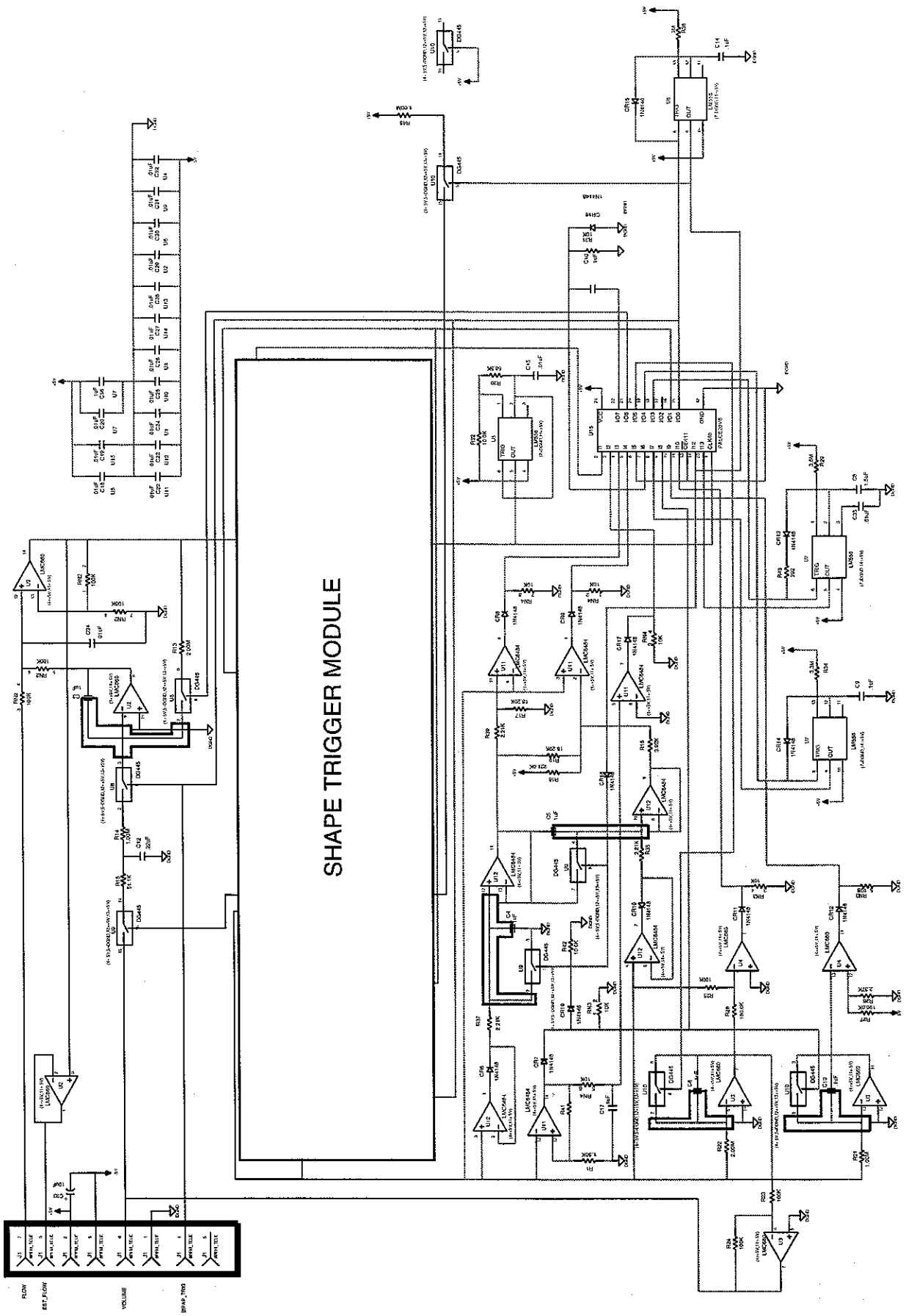
The schematics are intended to satisfy administrative requirements only. They are not intended to be used for component level testing and repair. Any changes of components could affect the reliability of the device, prohibit lot tracking of electronic components, and void warranties. Repairs and testing are supported only at the complete board level.

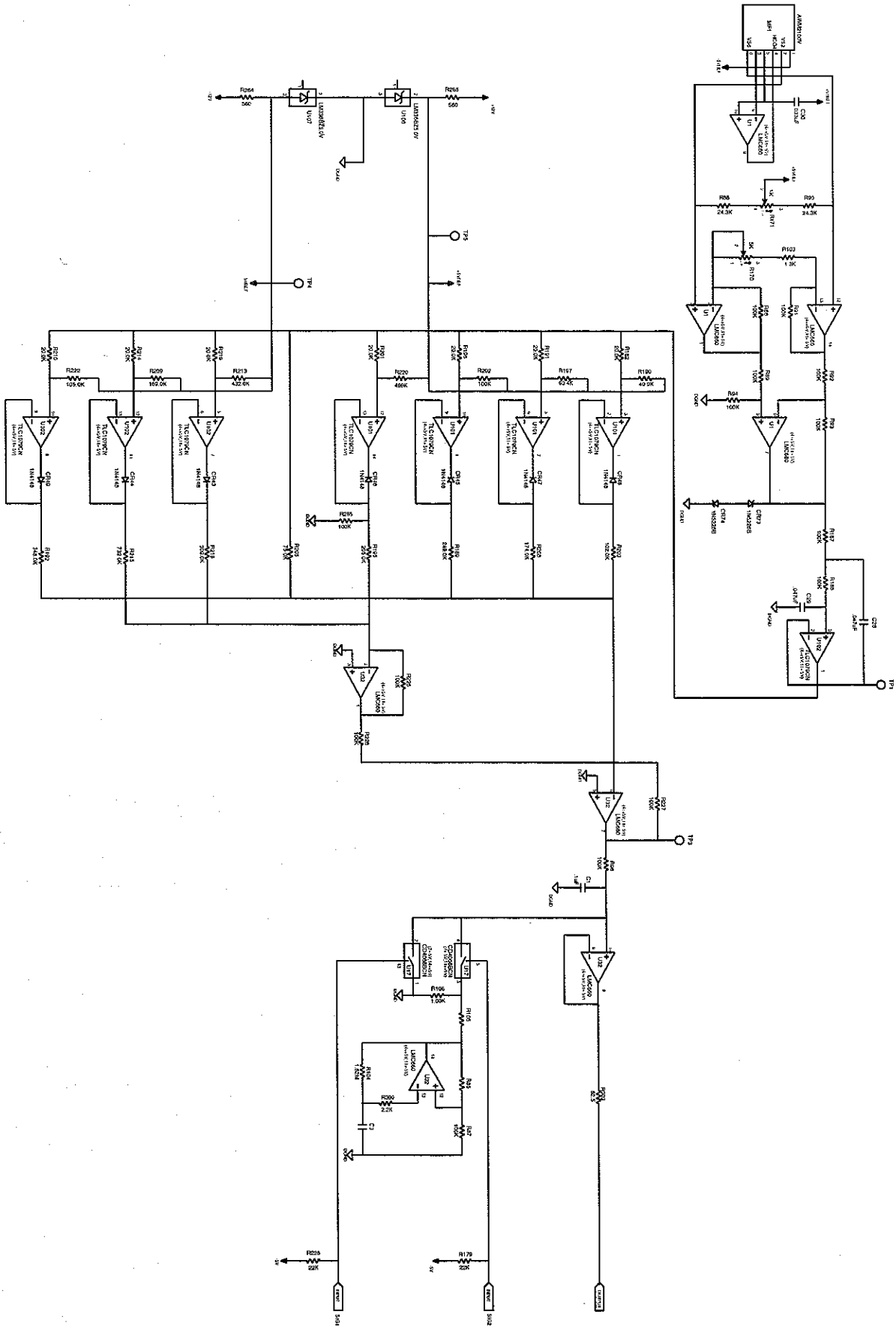
The schematics are of the revision level in effect at the time that this manual was last revised. New revisions may or may not be distributed in the future.

The schematics are presented in the following order: Motor Controller Board, Trigger Board, BCB for S/T 30, and BCB for S/T-D 30.

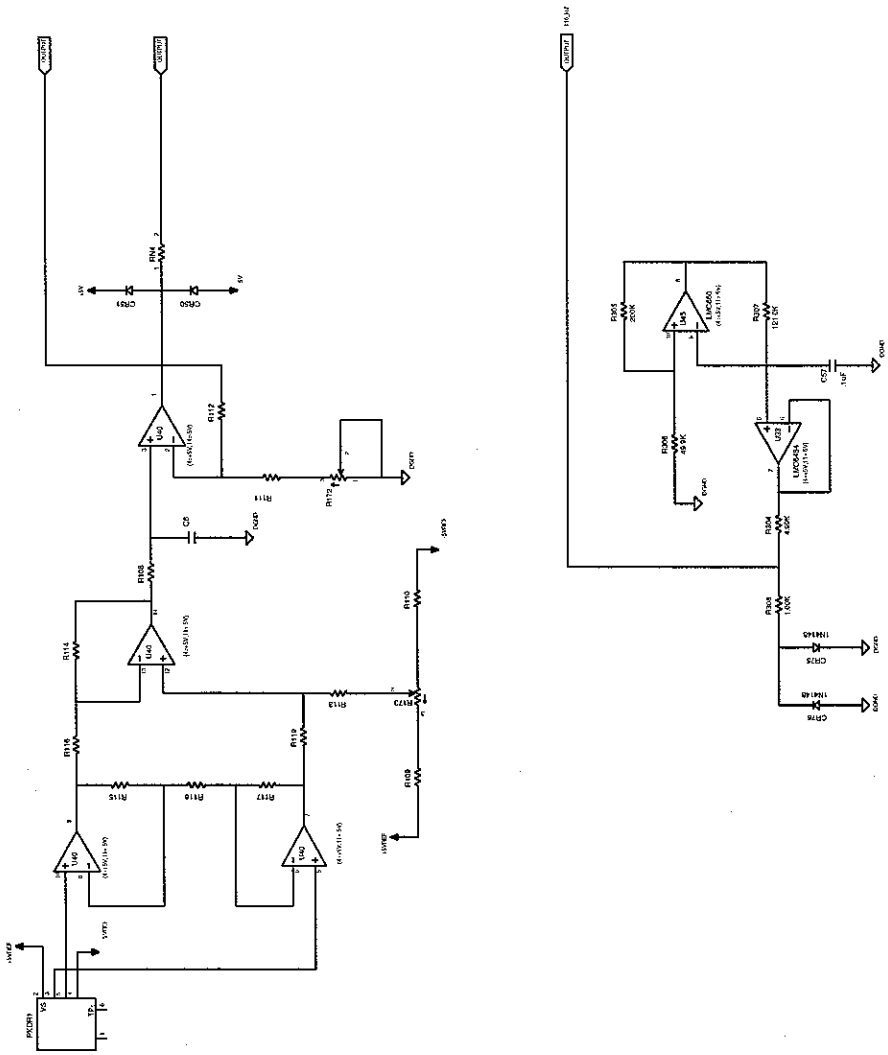


BiPAP 30 Service
Motor Controller Board
1 of 1

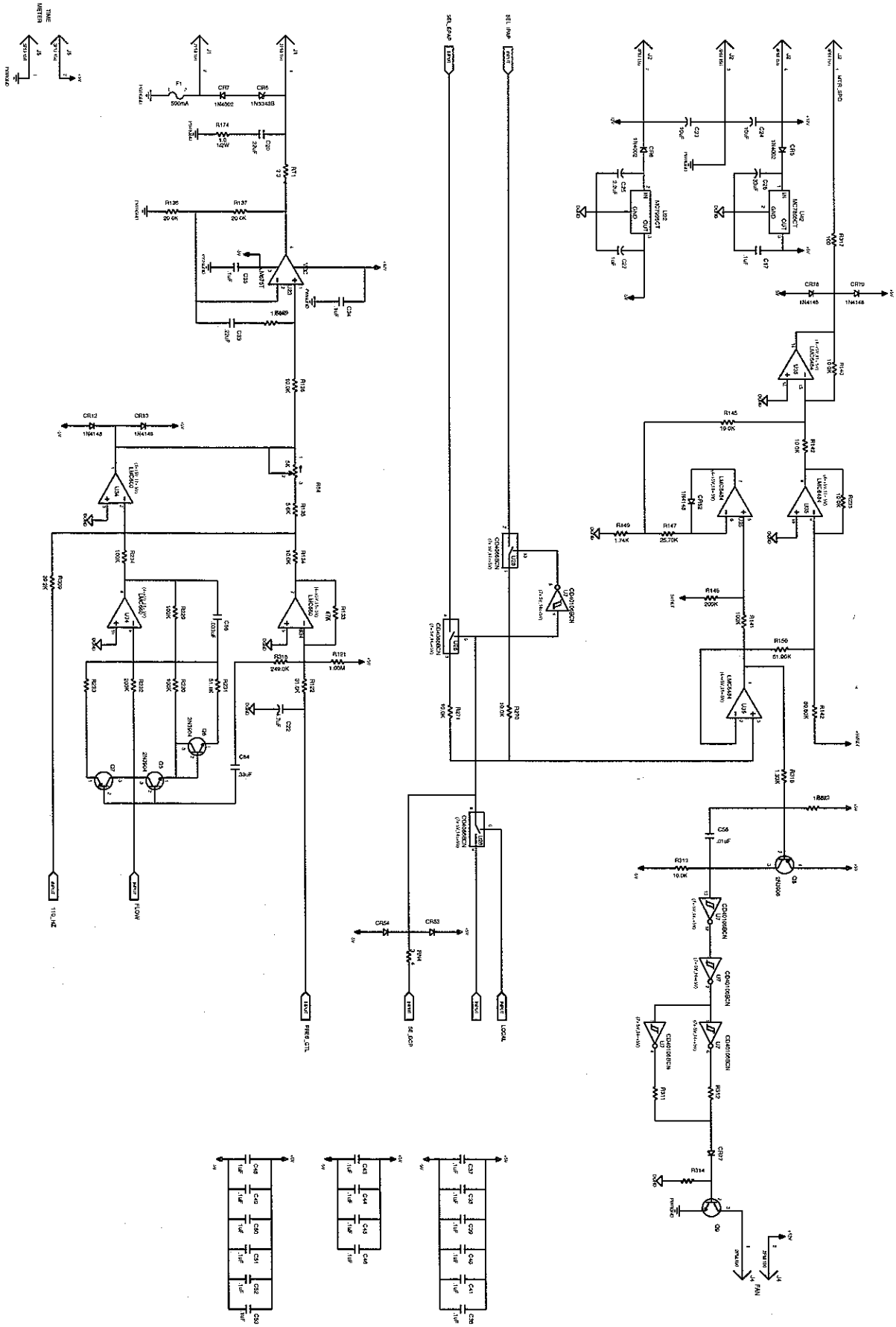

SHAPE TRIGGER MODULE
BiPAP 30 Service
Trigger Board
1 of 1
FLOW
EST_FLOW
VOLUME
BIPAP_TRIG



BiPAP S/T 30 BCB Service
1 of 4



BiPAP S/T 30 BCB Service
2 of 4



BiPAP S/T 30 BCB Service
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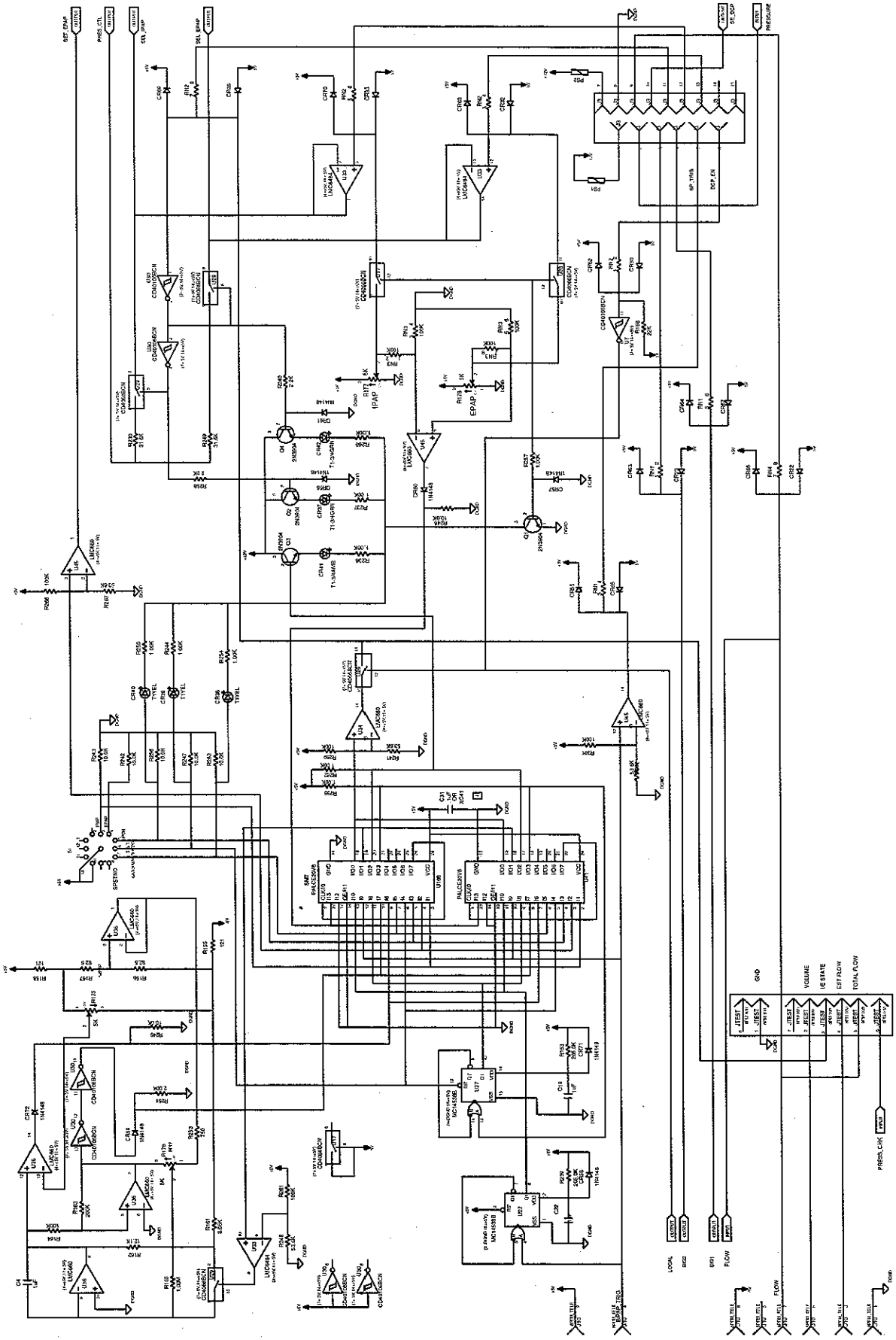

BiPAP S/T 30 BCB Service
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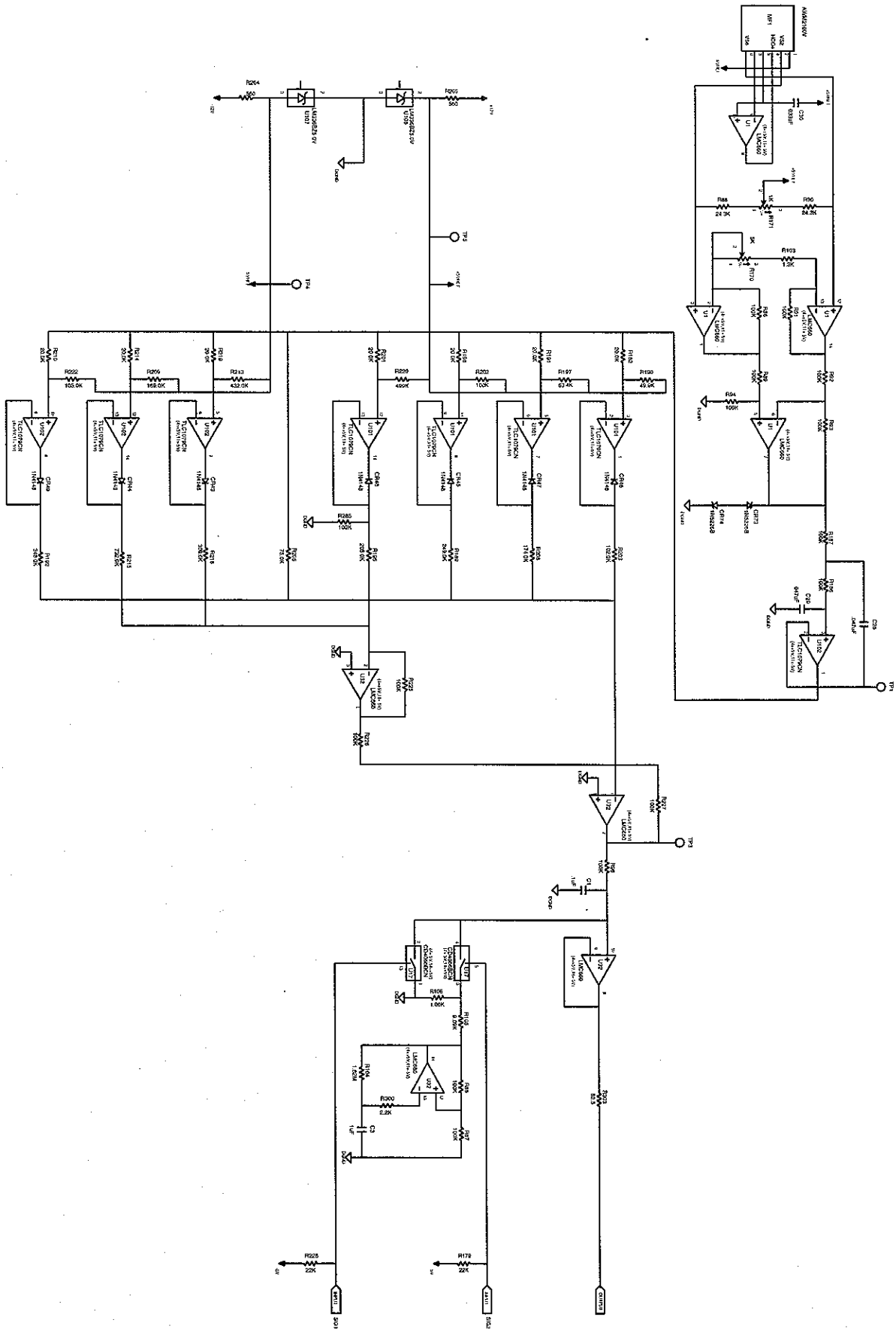
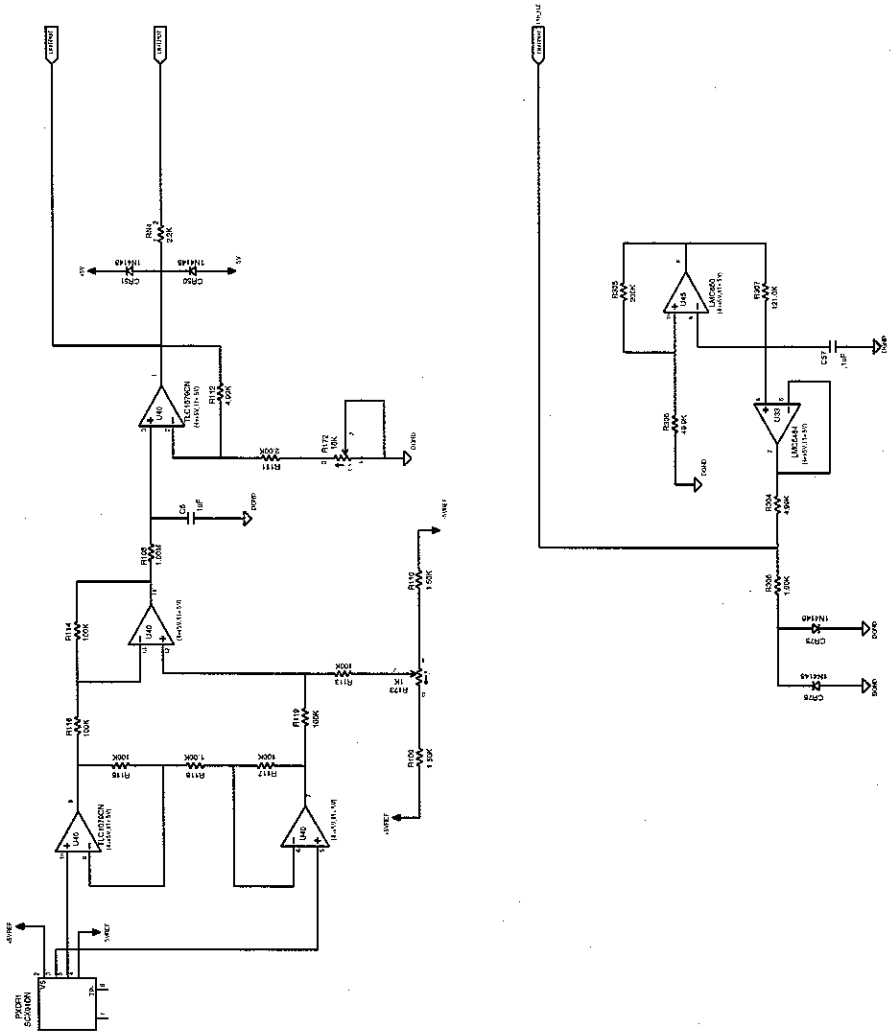
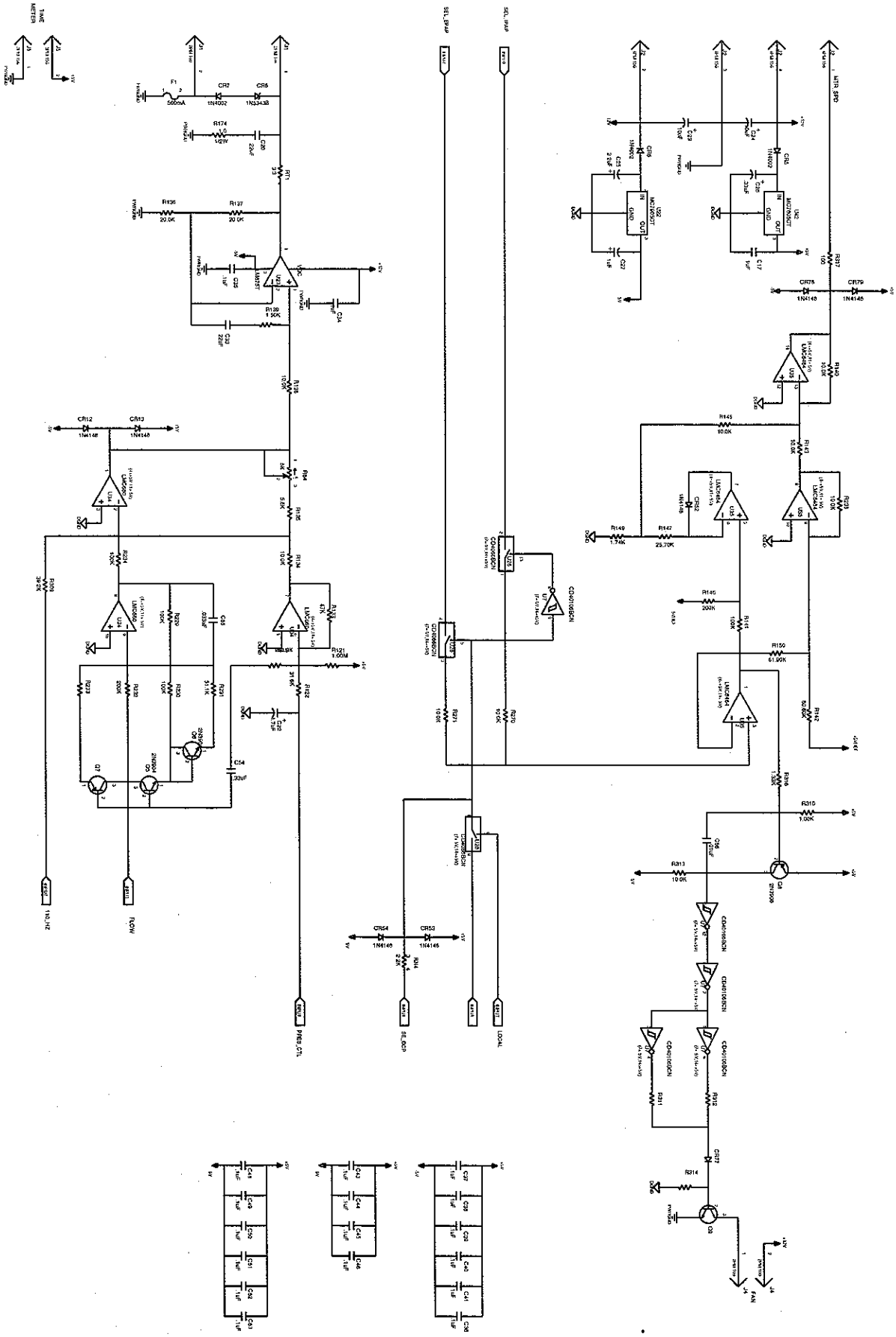


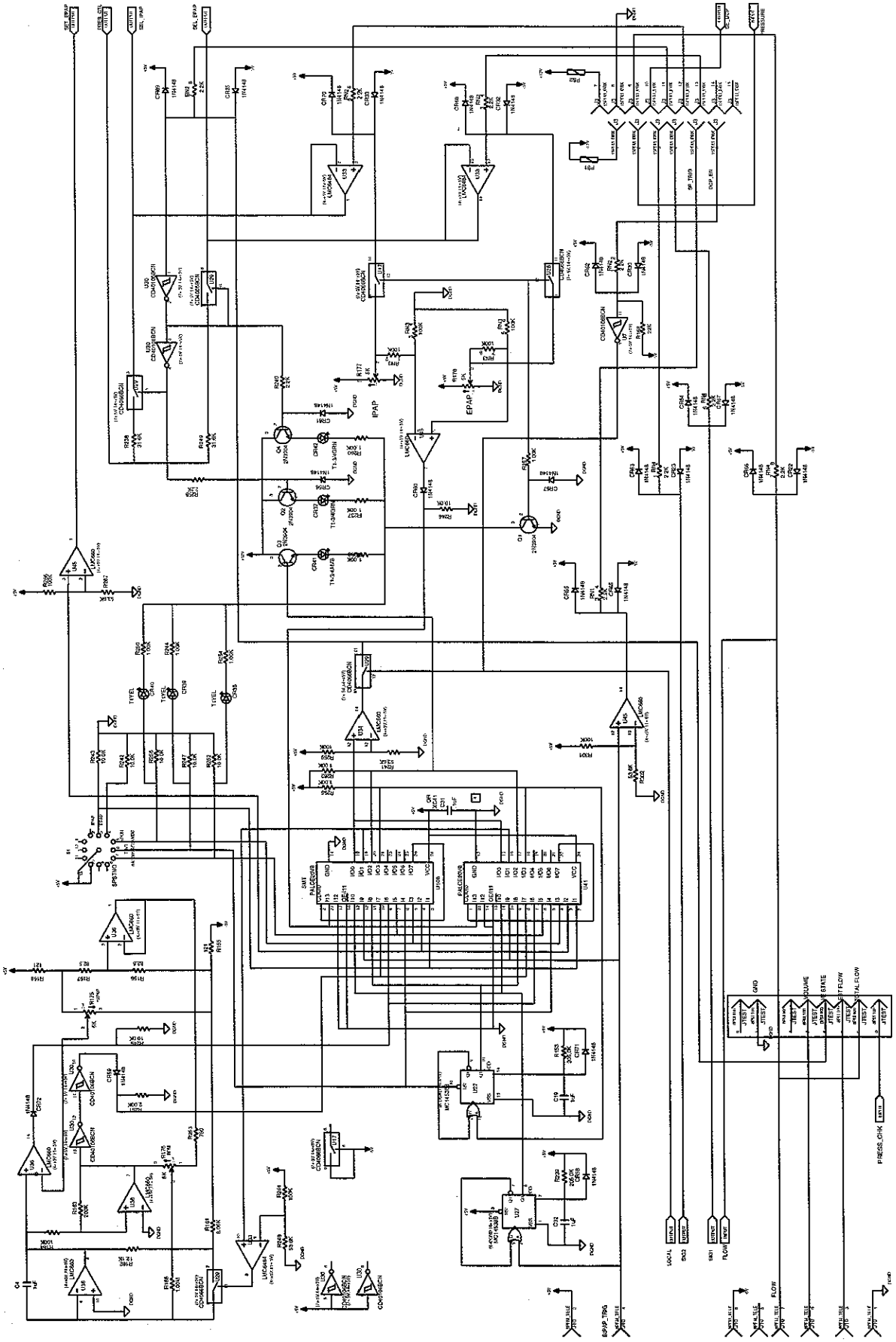
BiPAP S/T-D 30 BCB Service
1 of 4



BiPAP S/T-D 30 BCB Service
2 of 4



BiPAP S/T-D 30 BCB Service
3 of 4



BiPAP S/T-D 30 BCB Service
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